DOI: 10.15649/2346030X.3588
Aibi revista de investigación, administración e ingeniería. Volume 12, Number 1, Pág 108-120, January - April 2024, ISSN 2346-030X

PDCA methodology for improving process management in a natural products company

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Received: August 07, 2023.
Accepted: December 04, 2023.
Published: January 01, 2024.

Abstract— In the current context, production as an essential factor seeks to be developed in many companies through models that contribute to the reduction of merchandise rotation times, the number of defective products and greater productivity. This research was carried out with the purpose of implementing the methodology PDCA to improve process management in a natural products company. The research had a mixed approach (qualitative and quantitative), applied, with explanatory scope and quasi-experimental design. The missionary and support processes of a natural products processing company were taken as the object of research. The collection techniques used were direct observation and documentary review with instruments such as the observation guide and the recording of documentary information. Based on the initial diagnosis, implementation and comparative analysis, an increase in productivity from 0.632 to 1.644 bags/sol was obtained; The index of centralization to the strategy decreased from 4 to 0.8, as well as the index for process control increased from 75.35% to 80.37%. Likewise, better management was observed, which generated a decrease in average rotation times from 16 to 10 days, a lower number of defective products and better work performance. It was concluded that the PDCA methodology allowed the improvement of process management, also contributing to relationships and the work environment.

Keywords: implementation, PDCA methodology, missional processes, support processes, natural product.

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Peer reviewing is a responsability of the Universidad de Santander.

How to cite this article: H. D. García-Juárez, C. Bustamante-Ochoa, F. Carpio-Delgado, Y. M. Bravo-Chávez, “PDCA methodology for improving process management in a natural products company”, *Aibi research, management and engineering journal*, vol. 12, no. 1, pp. 108-120 2024, doi: 10.15649/2346030X.3588

I. INTRODUCTION

Faced with the needs of an increasingly demanding market, it is essential that companies adopt production systems that make continuous improvements in each of their processes. However, the factors are not clear due to the complexity of the elements involved. In this sense, the maintenance of high labor productivity is impacted by a series of factors, some directly linked to the organization and others that derive from external issues, so it is crucial to develop internal actions in the company to reduce the factors that affect all aspects of the business [1].

In the case of the company, common difficulties have been detected, such as the lack of an aligned strategy, absence of production and control plans, poor working environment, deficient space administration and quality management, as well as problems in maintenance, constant personnel training, plant distribution, safety, workers' health and even the lack of plans to penetrate the market.

Despite this, with solutions in sight, process improvement techniques and tools are widespread today in industrial companies. Many of these processes and technologies have found a wide range of applications in various sectors [2]. In this sense, the purpose of this research was to implement the PDCA (plan, do, check, act) methodology for the improvement of process management in a natural products company.

II. THEORETICAL FRAMEWORK

Continuous improvement: PDCA methodology

Continuous improvements are part of the concepts that prevail in the strategic management of companies today [3]. In turn, the ability to meet demand, as well as to adapt to new activities and eliminate those that provide little or no value, is something that organizations are working on, making great efforts to increase the visibility of the real-time status of their supply chain network, in addition to reducing waste, speeding up response times, simplifying the structure of both products and processes, and improving the quality of performance.

One of the most efficient methods that allows continuous improvements is the Deming cycle [4]. This is a continuous improvement method also known as PDCA (plan, do, check, act) or PDCA (plan, do, check, act). The PDCA cycle allows the creation of a short-term improvement plan in which several methods can be used to address a challenge; the goal is uniformity. Authors such as La Verde et al [5] argue that the planning, execution, control and continuous improvement of processes are closely linked to the PDCA cycle. In turn, this is a conventional quality management tool that has enormous potential [6]. On the other hand, excellent quality tools that help reduce the number of defective components include the PDCA cycle, with the auxiliary use of Pareto diagrams and flowcharts [7].

The long-term organization in the various companies involves the creation of a functional strategic plan with respect to their immediate needs; that is why the use of the so-called Deming cycle or PDCA process has become essential to achieve favorable results in product management and cost reduction. This strategic tool is based on the continuous improvement of services and products; at the same time, it allows pointing out possible errors and problems that may arise in the process, as well as offering different answers to specific obstacles and considering actions for future use [8]. In this way, the different organizations that resort to this concept will observe that the company's profitability will increase over time, due to continuous improvement planning that leads to the progressive reduction of production costs [9].

This method can be adapted to the demands of the market, since by responding optimally to the problems that arise in a given context, it will increase competitiveness among companies, both in products and services [10]. The process consists of four stages that are not independent of each other; on the contrary, each one follows the other with a linearity that allows each of them to have an effect on the other; these stages are: plan, do, verify and act. When "planning", the origins of the problems that arise will be determined; in the "doing" stage, planning will be initiated based on the context in which it is found and subsequently carried out; when "verifying", it is visualized how the plan is executed; and in the "acting" stage, the result obtained from that plan of action is shown in order to articulate it in the future if the situation requires it [8]. Likewise, the execution of the process is related to analysis and decision making, which provide a systematic organization based on the results obtained thanks to statistical figures [11].

Considering the stages of the process, the Deming cycle provides the optimization of each plan that is carried out, to obtain a progressive improvement that has favorable results for the company. Therefore, the process never ends, but is constantly being renewed and updated to be projected to future problems; this allows the response to be more comfortable to carry out [12]. The work environment maintains in its bases several aspects to take into account, the same that are appreciated both in the physical and emotional environment, and take importance in the employee's performance [13]. With this, the company seeks to increase productivity and promote motivation by having the human resource in a state of well-being.

Plant layout

The company will seek to position itself in a competitive terrain, and to this end it will carry out an operations strategy that, when carried out, will profitably manage the resources it brings with it [14]. One of the operations is the distribution of plants, which makes it possible to clarify the processes to be carried out, since it facilitates group decision-making and maintains unity among workers to seek a solution to the various problems that arise [15]. On the other hand, companies that do not carry out this operation will suffer a clear deficiency in the organization of resources in their different areas [16]. With respect to the training plan, the company will prioritize the development of personnel so that they can adapt and respond appropriately to the strategic planning that the company has carried out, in addition to serving as a human resource for future challenges. [17].

5S Methodology

The company establishes orders in the execution of its work; however, it is also essential to have a system that allows it to keep the workplace in good condition; for this, the 5S methodology is of great help to prioritize order and cleanliness [18]. Regarding maintenance plans, the degree of demand in the industrial sector has increased as a consequence of market globalization and international competitiveness. Due to this fierce competition, it has been indispensable to start using various management methods and tools in the sector. Some companies have even increased the importance of maintenance in their production planning and strategy [19]. Similarly, in some companies, there is a large amount of data to be monitored and used as operational tools to support the right decisions and save maintenance costs. Prioritizing and selecting among multiple outcomes, however, is difficult [20]. On the other hand, it is emphasized that in installations using certain types of equipment, the technique of detecting failures at an early stage of their development is essential. To avoid catastrophic failures and unplanned shutdowns, problems must be detected early [21].

Quality management

Quality management has a direct impact on customer decisions. It is important to point out that the goal of smart factories is to increase productivity and reduce costs, but it is crucial to boost manufacturing competitiveness by increasing throughput and product quality. Therefore, to control product quality, it is essential for organizations to develop appropriate plans [22]. Similarly, it is essential to inspect surface defects to control product quality and identify equipment failures. However, due to the low level of automation in some manufacturing plants and the difficulty in discovering faults, defect inspection remains a problem. Different models can be applied to increase the intelligence and automation levels of the defect inspection process that affect quality [23].

Strategic planning

In terms of strategic planning, some factors that contribute to unpredictable changes in market conditions are globalization, accelerated development of technology and financial crises [24]. Consequently, companies must be able to continuously improve and, at the same time, adapt, so the achievement of strategic objectives and sustainable growth are based on the organization's ability to quickly and permanently adapt its core and ancillary talents to the external environment and context [25]. It is also important to consider that a strategic plan is important not only for the owners of the company, but also for employees and consumers. Therefore, it is essential that the components of the strategic plan are created in collaboration with all stakeholders [26].

III. METHODOLOGY

The research responded to an applied type of research that sought to materialize actions to provide practical solutions [27]. In addition, it responds to an explanatory level, which analyzes the relationship of the variables of the phenomenon, explaining reasons, events or situations in which the object of research is immersed [28]. Regarding the design, a quasi-experimental design was chosen, because the research was managed in a timeline sectioned into three parts: the diagnosis or pretest, the implementation and the posttest [29]. For the purposes of this research, the techniques of direct observation and documentary review were used, and as instruments, the observation guide and the recording of documentary information, as well as a photographic camera, stopwatch, Wincha and laptops.

As technological and digital materials, computer programs were used, such as: Strategic Plan, Balance Scorecard, Work Climate, 5S Methodology, Quality Costs, Strategic Radar, Process Map, Microsoft Office, Microsoft Excel and Microsoft Visio.

In relation to the collection of information, the unit of analysis, population and representative sample of the research [30], both missionary and support processes, of a natural products company were taken as a reference along with its collaborators totaling 915 involved in administrative, operational and production processes. In addition, the review of historical production records is highlighted for the collection of data based on information since 2018.

IV. RESULTS, ANALYSIS AND INTERPRETATION

The selected company is dedicated to the production of natural products, which has a map of missionary and support processes as shown in Figure 1.

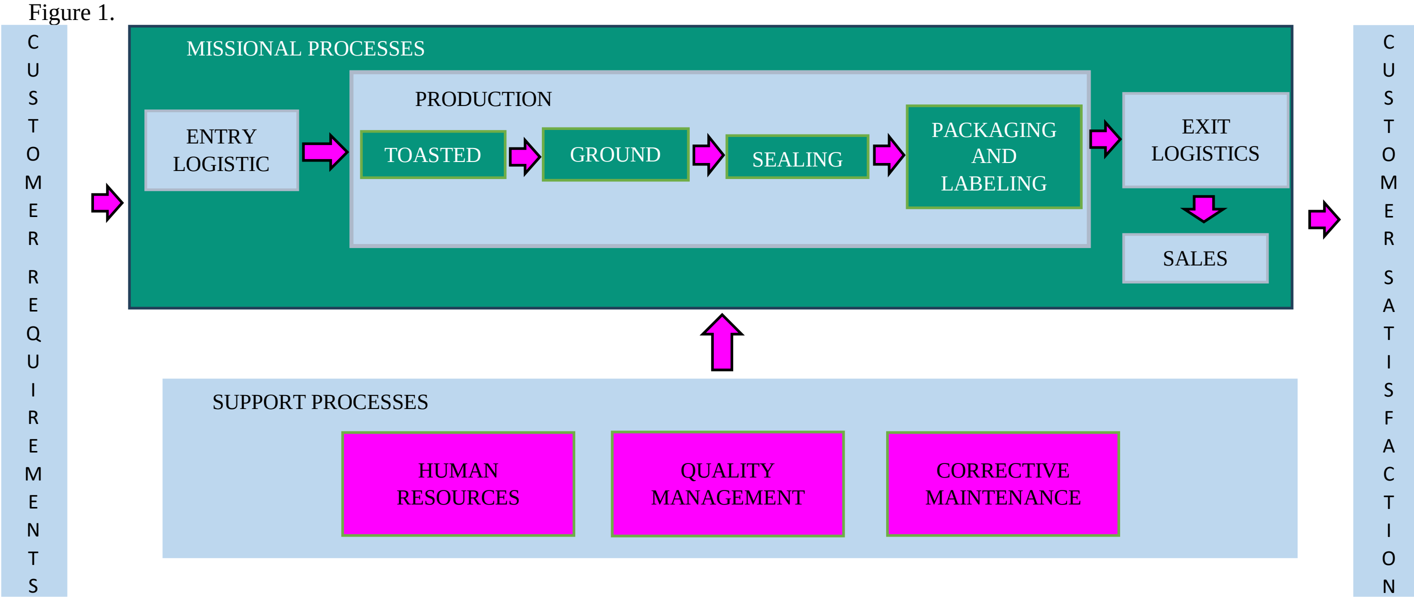

Figure 1: Map and processes of the natural products company.
Source: Own elaboration.

In order to achieve a diagnosis, the processes mentioned above were observed and reviewed, and then a brainstorming session was carried out to design an affinity matrix, resulting in an analysis based on operations management, quality management, working conditions, process management and strategic management, as shown in Table 1.

Table 1: Problem affinity matrix.

Deficient operation management		
-Absence of production plans - Poor inventory management - Cluttered warehouse	- Delays in the receipt of raw materials - Raw material shortage - Lack of working methods	- Lack of work schedules - Excess of unused products in the warehouse
Poor quality management		
- Old and inoperative machinery - Excess of defective products - Defective raw material	- Absence of a maintenance plan - Inadequate quality control - Absence of quality manuals	- Defective tools Lack of quality policies - Non-compliance with ISO 9001:2015.
Inadequate working conditions		
- Poorly motivated staff - Lack of incentives for personnel - Excessive workload - Absence of an induction program - Low working environment	- Salary dissatisfaction - Inadequate working environment - Inadequate condition of PPE - Clutter and dirt in the plant - Lack of danger zone signage	- Lack of communication between personnel - Lack of human talent management - High personnel turnover - Poorly trained personnel
Inadequate process management		
- Absence of a time research - Absence of role and function definitions - Inadequate plant layout	- Presence of downtime - Lack of process characterization - Lack of a value chain and lack of process mapping	- Inadequate process control - Excess travel - Non-standardized processes - Excess reprocessing
Lack of strategic management		
- Lack of strategic direction	- Lack of strategic plan - Absence of a system of indicators	- Low level of leadership

Source: Own elaboration.

As a consequence of the problems detected, we proceeded to collect and organize the values of productivity indicators, efficiency and effectiveness, which facilitates the analysis of the current situation. Figure 2 shows the record of productivity values for 2018.

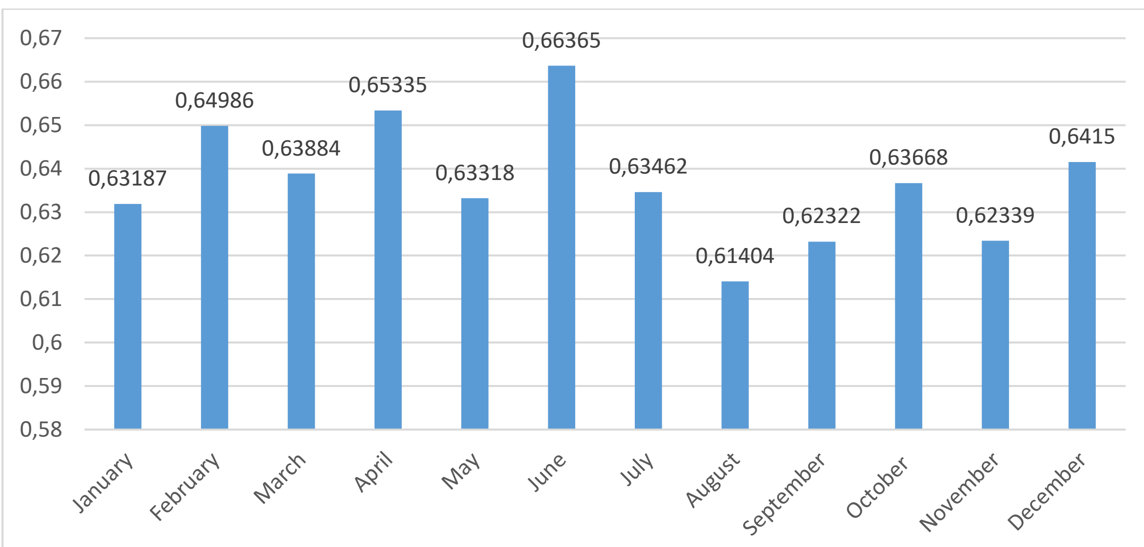

Figure 2: Productivity trend year 2018.
Source: Own elaboration.

Figure 2 shows that the maximum value was obtained in June with 0.66605 and an annual average of 0.63169. This indicates that the company currently has the capacity to manufacture less than one production unit, a value that places the current situation in a need for improvement status, however, the highest value is 0.6635 in the month of June because it is the month with the highest demand in the year.

In terms of effectiveness and efficiency, these indicators showed a similar level of trend to productivity, as can be seen in the compilation achieved and reflected in Figures 3 and 4.

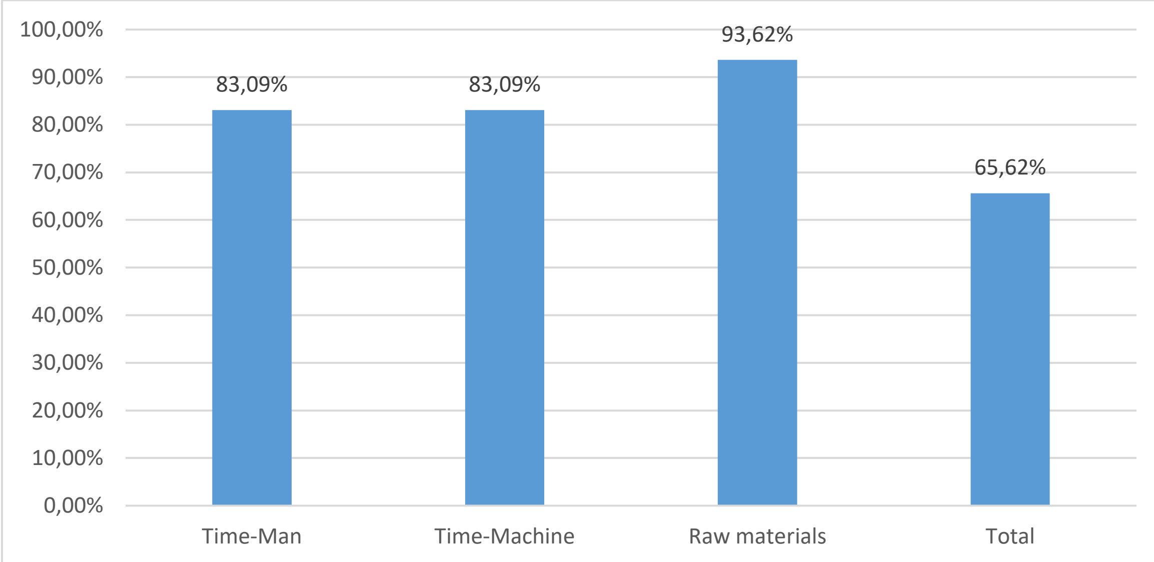

Figure 3. Status of the efficiency indicator year 2018.
Source: Own elaboration.

Figure 3 shows that the highest efficiency came from the raw material; however, on average, the process achieves only 65.62%, far below the theoretical values of an ideal expected efficiency of 90%, an aspect that supports the need for improvement in the management of the production process.

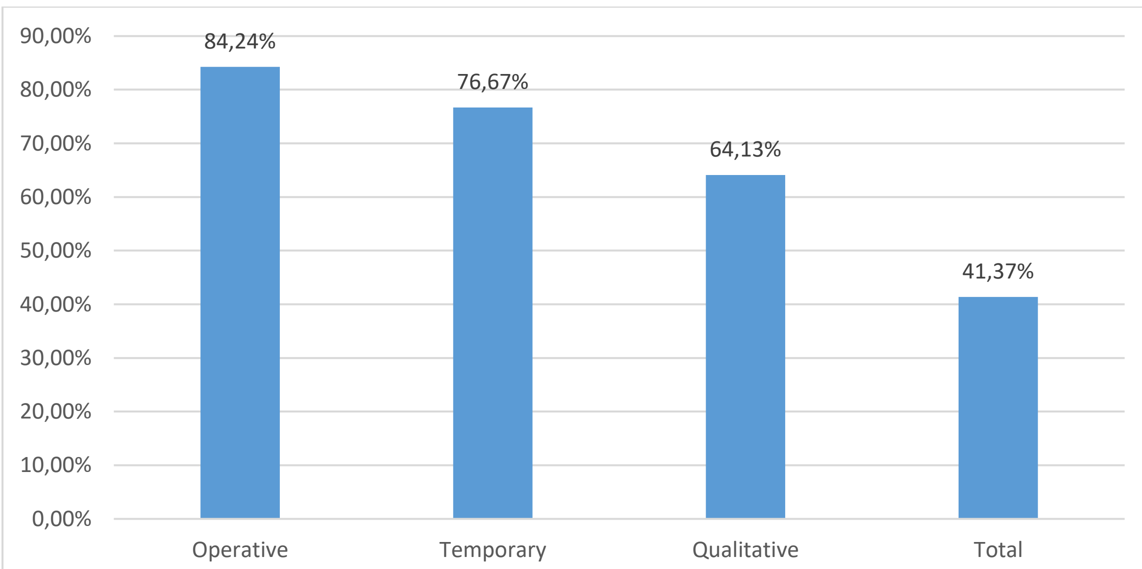

Figure 4: Status of the effectiveness indicator year 2018.
Source: Own elaboration.

Figure 4 shows that the total efficiency is located at a very low value of 41.37%, although the operational efficiency is 84.24% and the qualitative efficiency is 64.13%, which again shows the need to apply specific actions to increase these values, improving the management of the production process.

V. PROPOSED SOLUTION

The proposal consists of the implementation of the four phases of the PDCA methodology in both missionary and support processes in the company, because of the values indicated in the productivity, effectiveness and efficiency indicators obtained in the situational diagnosis in the pretest, as detailed below:

a. Planning phase

Once the entire process of diagnosing the improvement project had been completed, we proceeded to a planning process based mainly on three aspects, considering the indicators to be assessed throughout the process, the schedule of actions to be carried out and, finally, the budget to be used. First, the indicators used were grouped, defining the baseline and goals to be achieved, as specified in Table 2.

Table 2: Diagnostic indicators dashboard.

Indicator	Type	Unit	Baseline	Goal
Management indicators				
Total productivity	Growing	%	0.63169	0.65
Total efficiency	Growing	%	41.37	60
Total efficiency	Growing	%	65.02	80
Effectiveness	Growing	%	27.30	50
Strategic management				
Strategic radar index	Decreasing	Index	4	1
Process management diagnosis				
Indicator reliability index	Growing	%	75.35	85
Value creation index	Growing	%	44.04	70
Operations diagnostics				
Sesame rotation time	Decreasing	days	17	8
Canary seed rotation time	Decreasing	days	9	6
Linseed rotation time	Decreasing	days	8	3
Chia rotation time	Decreasing	days	30	15
Diagnosis of quality management				
Level of compliance with ISO 9001:2015 standard	Growing	Level	1.73	4
Rate of defective products	Decreasing	%	8.56	2
Overall maintenance rate	Growing	%	34.25	70
Process capability	Growing	Level	1.37	1.75
Diagnosis of labor performance management				
OSH guideline compliance rate	Growing	%	18.10	60
Work climate index	Growing	%	33.61	50
GTH index	Growing	%	56.77	70
Muther Checklist	Decreasing	%	67	20

Source: Own elaboration.

Once the indicators that would serve as the basis for the evaluation processes had been established, a timetable was defined for the implementation of the plans to be carried out over the course of a month and a half, as shown in Table 3.

Table 3: Continuous improvement project Schedule.

Activity	Duration (Days)	Home	End	**Year 2019**													
							September					**October**				**Nov.**	
				12	**19**	**26**	**2**	**9**	**16**	**23**	**30**	**7**	**14**	**21**	**28**	**4**	**11**
Evaluation of the current situation	64	12-Aug	7-Nov														
Implementation of 5S Plan	52	12-Aug	22-Oct														
Implementation of OSH Plan	12	23-Oct	11-Nov														
Implementation of the Strategic Management Plan	22	12-Aug	10-Set														
Implementation of the Quality Plan	32	20-Set	4-Nov														
Implementation of the Work Climate Plan	6	24-Set	1-Oct														
Implementation of the Maintenance Plan	2	30-Set	1-Oct														
Implementation of the Operations Plan	8	20-Set	1-Oct														
Implementation of the Plant Distribution Plan	10	14-Oct	25-Oct														
Implementation of the Training Plan (GTH)	21	25-Set	23-Oct														

Source: Own elaboration.

On the other hand, once the calculations regarding the impact of the proposed plans for the organization were estimated, the NPV was calculated, both without the application of the project and the estimates after its application, as shown in Table 4.

Table 4: Cash flow without and with project.

Incremental economic cash flow										
With Project						No Project				
Period	**0**	**1**	**2**	**3**		**Period**	**0**	**1**	**2**	**3**
Year	**2019**	**2020**	**2021**	**2022**		**Year**	**2019**	**2020**	**2021**	**2022**
Revenues		70,93	73,21	75,50		Revenues		84,62	87,38	90,16
Manufacturing Costs (Without Depreciation)		-24,192	-25,241	- 26,319		Manufacturing Costs (Without Depreciation)		-28,208	-29,456	- 30,737
Gross Profit		46,74	47,97	49,18		Gross Profit		56,41	57,93	59,42
G. Administration		-10,092	-5,995	-6,098		G. Administration		-6,632	-5,602	-5,727
G. Sales		-5,320	-5,491	-5,663		G. Sales		-6,347	-6,554	-6,762
Depreciation		-1,100	-1,100	-1,100		Depreciation		-1,100	-1,100	-1,100
Amortization		0	0	0		Amortization		-10,126	0	0
Operating profit (EBIT)		30,23	35,39	36,32		Operating profit (EBIT)		32,20	44,67	45,83
Income Tax (29.5%)		-8,919	-10,441	-10,716		Income Tax (29.5%)		-9,501	-13,179	- 13,521
Net income		21,31	24,95	25,61		Net income		22,70	31,49	32,31
Depreciation		1,100	1,100	1,100		Depreciation		1,100	1,100	1,100
Amortization		0	0	0		Amortization		10,126	0	0
Operational F.C.		22,41	26,05	26,71		Operational F.C.		33,93	32,59	33,41
Tangible Assets						Tangible Assets				
Intangible Assets						Intangible Assets	-10,126			
Working Capital Inv.	-1,739	-91	-55							

Incremental FC	-10,512	11,531	6,532	6,702
VA	-10,512	11,044	5,991	5,888
Accumulated VA	-10,512	532	6,523	12,411

Source: Own elaboration.

An increase in net profit is observed with the implementation of the project, which is mainly due to defective products and employee motivation, as well as a decrease in downtime due to a better distribution of the plant, which reduces transfer times and space congestion.

b. Phase do

In the second stage of the PDCA, what was planned in the previous stage was implemented; however, it was not possible to implement each of the plans, since this decision was subject to the investment that the organization was willing to make, since they required greater resources, therefore, the management was forced to prioritize the plans according to its own analysis.

The implementation of the strategic management plan was carried out with the execution of the plans. Thus, initially, meetings were held with management personnel and then the respective capitations were made to ensure that the information was shared, thus, the actions began with public approval and training according to the strategic objectives. Subsequently, we moved forward with the approval and training of the process management plan for operators, and then continued with the approval by the production manager of the raw material requirements plan and production planning.

In addition, with respect to the quality management plan, we authorized the implementation of the use of boxes as secondary packaging for transporting the bags. Ergonomics training was also provided to correct postures during the use of the machines in order to avoid injuries.

In relation to the maintenance plan, the general management approved the maintenance schedule for the machines, and the machines were booked. The training plan was also approved, together with the 5S plan. Documents, waste and finished products were then classified. Subsequently, the shelves, work equipment, desks and various spaces such as the sink were tidied up, culminating with the cleaning of common areas, shelves, machinery and production areas.

With the implementation of the plant distribution plan, a new layout was proposed and then the relational diagram with the proposed layout was made again, obtaining favorable results in mobility and weight loads, which was complemented by the occupational health and safety plan, where training was conducted, PPE was purchased and respective signage was placed in each of the work areas. With regard to the work environment, after the budget was approved by management, recycling bins were installed, and lockers were installed in the locker room area. Finally, after the budget was approved, a fair was set up as part of the market penetration plan.

c. Phase verify

This stage is considered a test period in which the effectiveness of the plans implemented is compared with the objectives previously established for the project. This stage served as feedback to continue with the successful plans or, otherwise, to adjust and correct the discrepancies detected. Subsequent to the implementation of the proposed plans, an improvement was reflected in the organization's management indicators, since each plan directly and indirectly contributed to its progress, as can be seen in Figure 5.

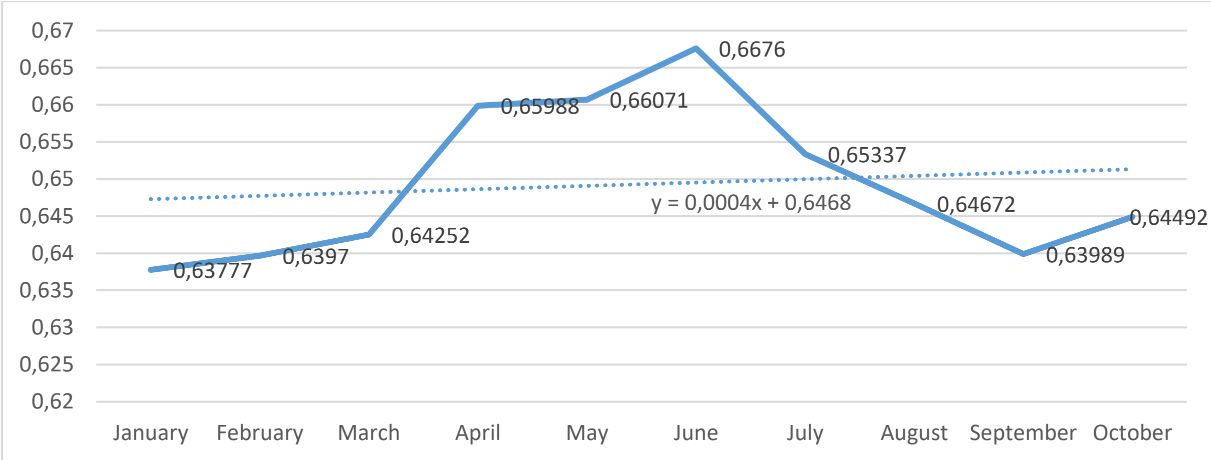

Figure 5: Total productivity index
Source: Own elaboration.

After the implementation of the proposed plans, there was a positive trend in productivity compared to the previous year, showing an increase of up to 3% during the months following implementation, with the highest peaks in the months with the highest production. On the other hand, with effectiveness and efficiency calculations, results were obtained as shown in Figure 6.

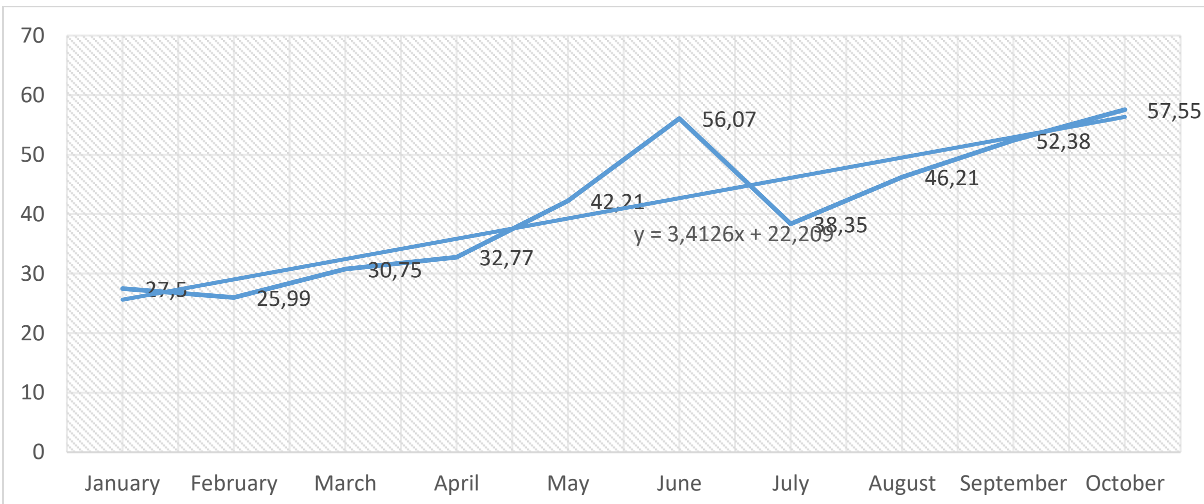

Figure 6: Effectiveness index.
Source: Own elaboration.

Effectiveness, therefore, increased by an average of 13% compared to the previous period, demonstrating the impact of the plan on the organization as a whole. Subsequently, the PDCA methodology was implemented. The strategic radar was remeasured to define the organization's new approach to its strategy. Once the strategic management plan was implemented, the company was able to determine that it has a clear mission and vision, as well as strategic objectives to which to aspire. The evolution of the indicator can be seen in Figure 7.

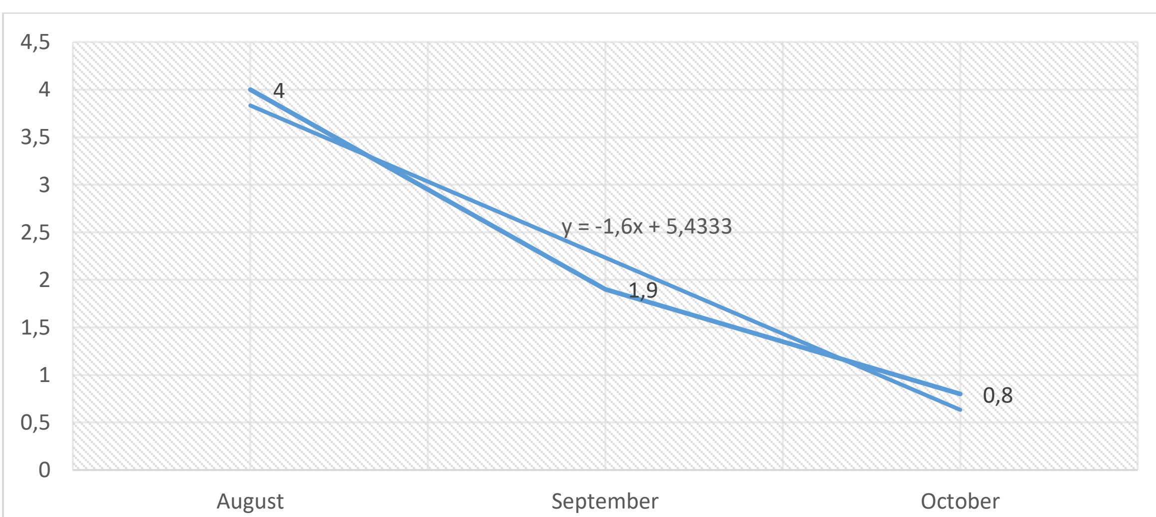

Figure 7: Centralization index to strategy.
Source: Own elaboration.

One month later, after the full implementation of the plan, the average level of distance from the strategy was 1.90, thanks to the proposed strategic direction and the definition of the strategy. The last measurement was an average of 0.8, taking into account the five principles analyzed in the "plan" stage, carried out in October.

The development and implementation of the PDCA methodology ensures that the resources, as well as the objectives of each process, are oriented to provide a quality product to both internal and external customers, so it was necessary to have reliable indicators for measurement, as well as to monitor the evolution of performance and measure the value creation of all processes to identify opportunities for improvement. In the case of this research, the value chain was analyzed, where after characterizing the existing processes and those proposed in the "planning" stage, an increase of 5.02% in reliability was observed, as shown in Figure 8.

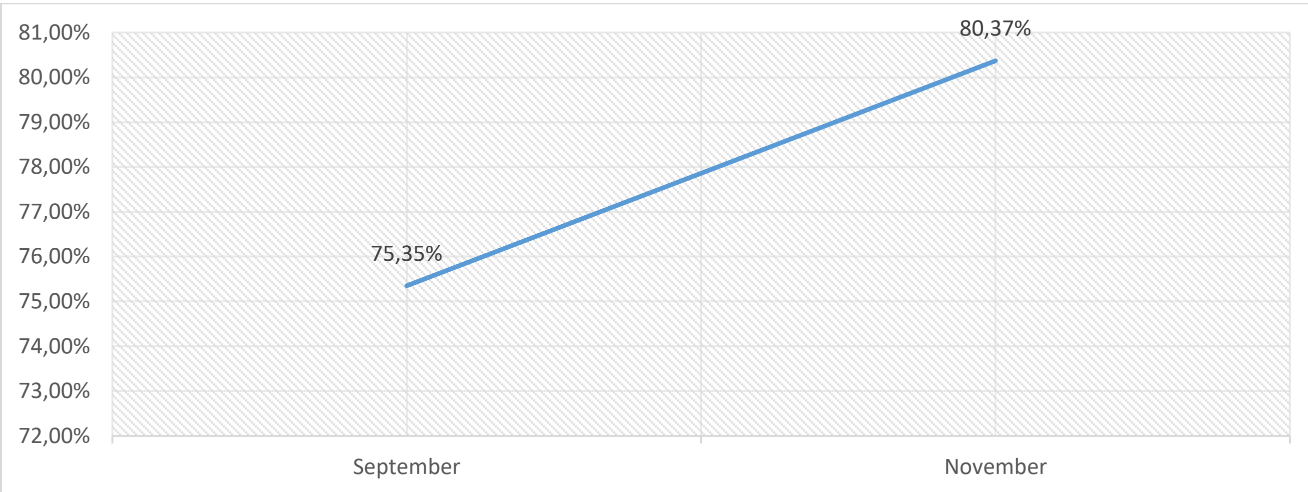

Figure 8: Value creation index in %.
Source: Own elaboration.

This is a consequence of the improvement in the understanding and correct use by the operators as well as in the management of information, which allowed decisions to be made that contributed to the good management of the company. Likewise, there was an improvement in the value creation index, as shown in Figure 9.

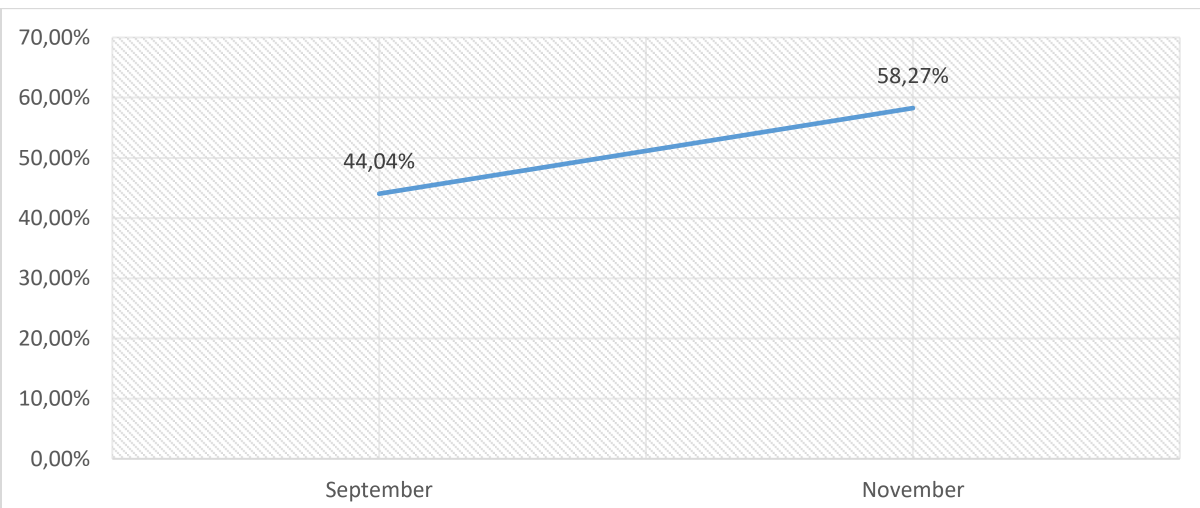

Figure 9: Value creation index in %.
Source: Own elaboration.

According to the processed data, an increase of 14.23% in value creation was observed, which demonstrated the effectiveness in the execution of processes, as a result of standardization, training and lectures received, policies and strategy implementation. Subsequently, the impact of the operations management plan, which initially presented inventory turnover problems, was verified. For its verification, the period October 2019 was analyzed separated into weeks. The indicator was transformed into turnover days for a better understanding, as shown in Figure 10.

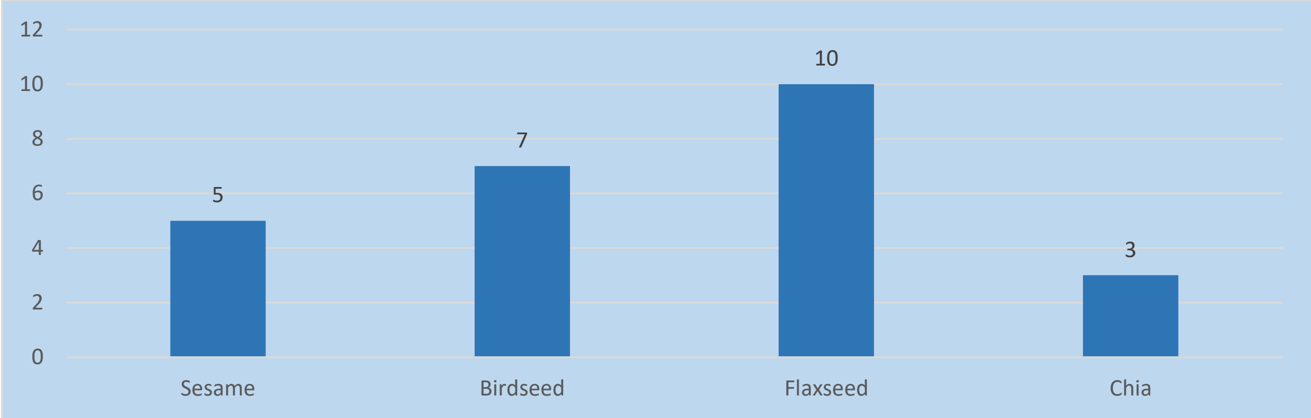

Figure 10: Post-implementation inventory turnover.
Source: Own elaboration.

The initial seed rotation days were as follows: for sesame, 4 days; for canaryseed, 3 days; flaxseed, 4 days; and chia, 5 days. With an average delay of one day, which generated rotation problems, it was possible to increase the rotation of the merchandise by an average of 62% among the four seeds. On the other hand, with regard to the quality management plan, the rate of defective products was considered to verify the scope. This is one of the main problems, so the inspection of the batches of 200 units was carried out to measure the percentage of defective products, confirming a decrease of 3.96 %, which corresponds to an average of 8 units per batch, which meant that the actions taken gave positive results, as can be seen in Figure 11.

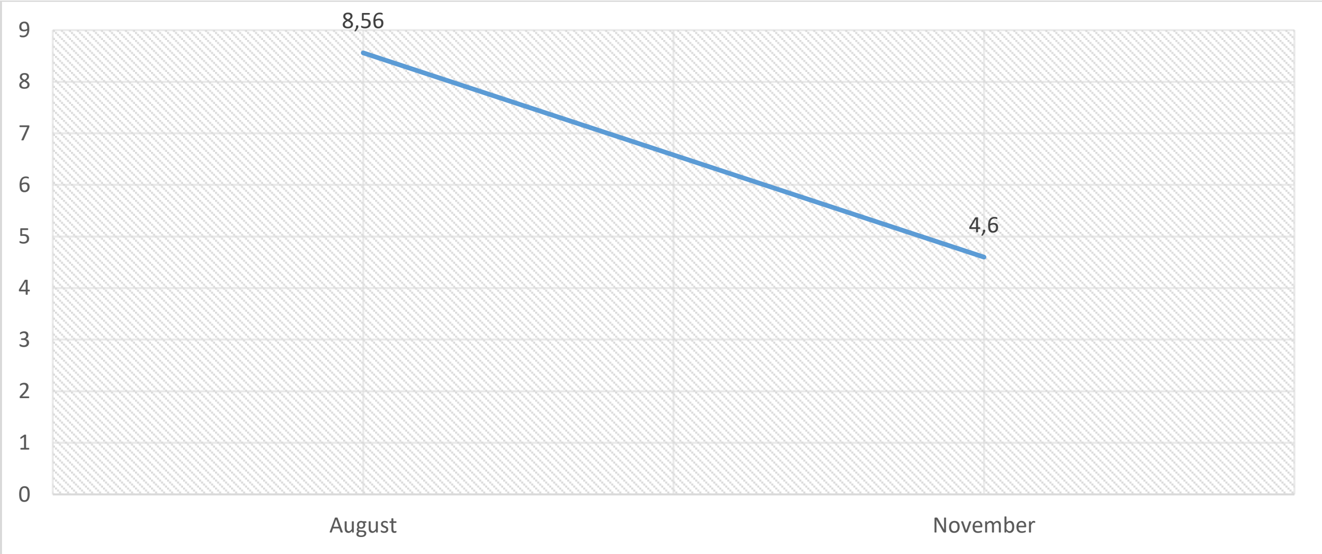

Figure 11: Post-implementation defective product rate.
Source: Own elaboration.

It is worth noting that the decrease observed was due to the implementation of the PDCA methodology in the sealing process, which involved the preparation of a product transport guide that was distributed to the operators in charge, training and the use of boxes to transport the products for distribution.

On the other hand, the labor performance management plan is presented, with the purpose of measuring how each employee felt in the workplace with respect to his or her colleagues and bosses. A series of measurements were taken to evaluate the evolution of each work climate management indicator, as shown in Figure 12.

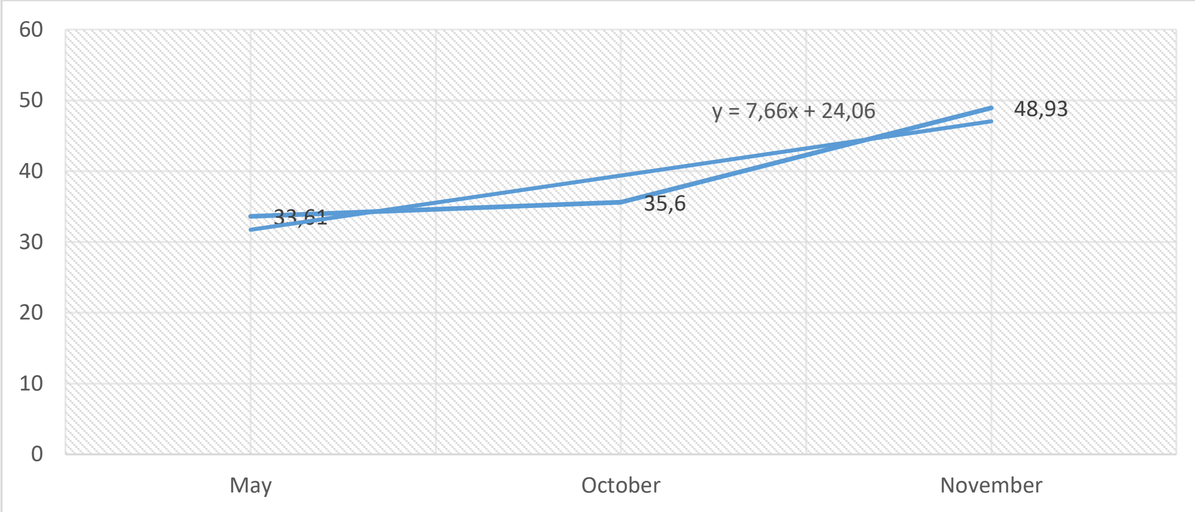

Figure 12: Post-implementation work climate index
Source: Own elaboration.

The work climate plans began to be implemented in October. After implementation, an increase of 13% was observed. On the other hand, after implementation, the balance scorecard indicators were measured again to determine their evolution, to encourage the company to meet the objectives proposed in this new phase.

Based on the results obtained after the implementation of the PDCA methodology, it is observed that, in the case of the raw material rotation index in incoming logistics, as well as total production efficiency and compliance with Law No. 29783, Occupational Health and Safety Law, were the indicators that achieved above the goals, unlike the 5S index and human resources in general with very poor ratings.

d. Phase act

After observing the remaining weaknesses and reviewing the actions in the areas of production planning and control, inbound logistics, production, outbound logistics, commercial, after-sales, purchasing, human resources, marketing, quality management, maintenance, safety and occupational health, the established plans were repeated with improvements, in this case, concentrating the actions on the 5S plan, which continues to show weaknesses, as well as on training and the promotion of performance incentives. Table 13 shows the details.

Table 13: Control panel-Process map indicators.

Management indicator	Type	Unit	Baseline	Goal	After improvement
Total productivity	Growing	%	0.63169	0.65	0.64384
Total efficiency	Growing	%	41.37	60	65.95
Total efficiency	Growing	%	65.02	80	78.82
Effectiveness	Growing	%	27.30	50	52.05
Strategic management					
Strategic radar index	Decreasing	Index	4	1	0.8
Process management diagnosis					
Indicator reliability index	Growing	%	75.35	85	80.37
Value creation index	Growing	%	44.04	70	58.27
Operations diagnostics					
Sesame rotation time	Decreasing	days	17	8	6
Canary seed rotation time	Decreasing	days	9	6	4
Linseed rotation time	Decreasing	days	8	3	3
Chia rotation time	Decreasing	days	30	15	10
Diagnosis of quality management					
Level of compliance with ISO 9001:2015 standard	Growing	Level	1.73	4	2.68
Rate of defective products	Decreasing	%	8.56	2	4.60
Overall maintenance rate	Growing	%	34.25	70	58.58
Process capability	Growing	Level	1.37	1.75	1.69
Diagnosis of labor performance management					
OSH guideline compliance rate	Growing	%	18.10	60	69.57
Work climate index	Growing	%	33.61	50	48.93
GTH index	Growing	%	56.77	70	76.08
Muther Checklist	Decreasing	%	67	20	36.67

Source: Own elaboration.

As shown in Table 13, it was observed that, despite certain adversities in the implementation of projects in the production area, significant improvement impacts were generated in most cases; however, it is considered necessary to implement a department to maintain the pace of improvement of the changes achieved and continue with the progress to achieve the goals in each of the indicators.

VI. CONCLUSIONS

At the conclusion of the research, a general improvement was observed in the different process indicators, highlighting in the management indicators total efficiency with an improvement of 59% and effectiveness with an increase of 91%, in relation to strategic management the strategic alignment obtained an improvement of 400% going from 4 pts. to 0.8 being even lower than the goal which was 1, which shows a better understanding of the importance of management in the organization. Also, among the outstanding results, the lowest average turnover time of 10 days (about 1 and a half weeks) less was obtained in the raw materials sesame, canary seed, flaxseed and chia, with an average improvement of 169%, which revealed a better inventory management that led to a better management of operations.

Similarly, an improvement in quality management was identified, due to the 35% increase in the rate of compliance with ISO 9001:2015 standards, an increase that occurred thanks to constant monitoring of compliance with the quality manual. In relation to defective products, an 86% improvement was achieved, a result that was due to better handling of finished products and changes in the use of the sealer. The overall maintenance rate reached a 42% improvement, following the completion of maintenance sheets and the application of the proposed schedule, thus reducing failures and the average repair time. On the other hand, the occupational health and safety compliance rate stood out with an increase of 74%, as a result of the health and safety plans; the improvement of the work climate index rose by 31%. Finally, the results were compared with the Muther Checklist with an improvement of 83%, confirming the existence of significant improvements in the company.

The improvements achieved in this research coincide with the fundamentals of the phases of the PDCA or PDCA cycle, by analyzing the processes and implementing the tools of the Lean philosophy, reducing, among other aspects, time losses and defining supply patterns, resulting in a reduction of movements. Likewise, the combination of the PDCA cycle with the concept of evidence-based management served as a basis for developing a procedural framework.

VII. RECOMENDATIONS

Considering the implementation and programmed use of the standard method of total productive maintenance in combination with the PDCA cycle, with tools such as the Pareto chart and the fishbone diagram, it was possible to improve the product configuration time by one month, increasing the availability value and the value of the overall efficiency of the equipment.

Take into account the fundamentals of Statistical Process Control (SPC) together with the PDCA cycle, and the support of the Cause and Effect Diagram, Nominal Group Technique and "why, what, where, when and how method". Similarly, carry out periodic analysis using the own diagram for process analysis (DOP) to identify nonconformities and determine in a context where large losses were diagnosed in the handling of raw materials and inputs, thus generating significant increases in production with high quality.

In a context favorable to the health of workers, continuously review the principles of risk management in occupational safety and health, on potential aspects related to the uncertainty of the requirements of ISO 45001:201. This is due to the fact that the sole application of the PDCA process does not guarantee the totality of the improvements, due to applicability obstacles in many cases and in others the process itself. From this guideline it is necessary to take into account the requirements and readjustments of improvement, which are adapted to the realities that arise over time in the company so that favorable effects are generated and maintained.

Finally, at the pace at which the market needs to advance, it is essential to improve methods and techniques that, according to what has been observed, reach different achievements in the different processes. Therefore, it is essential to reaffirm the proper functioning of planning in itself in the context of the company, as well as to constantly explore alternative methods whose nature could provide superior favorable effects, understanding that the dynamics of current companies are in constant change and adaptation, in which systems and strategies with achievements in the past tend to become obsolete.

Declaration of conflicts of interest
The authors have declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Financing
The authors received no financial support for the research, authorship and/or publication of this article.

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